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Joint dynamics for the underlying asset and its implied volatility surface: A new methodology for option risk management

This paper develops a dynamic joint model of the implied volatility (IV) surface and its underlying asset which is tractable and seamless to estimate. It combines an asymptotically well-behaved, parametric IV surface representation with a two-component variance, and non-Gaussian asymmetric GARCH specification for the underlying asset returns. Estimated on S&P500 index return and option data for the 1996-2020 period, the model captures the IV surface movements well and uses them to obtain an improved fit on index returns. It also proves to be an effective risk management tool, producing reliable Value-at-Risk estimates for straddle and strangle positions, and accurate forecasts of the VIX distribution.